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Indiana Historic Bridge Inventory

Methodology to Identify Select and Non-Select Bridges

Prepared for

Indiana Department of Transportation

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A MEAD & HUNT company

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1. Executive Summary

In fulfillment of Stipulation II.B of the Indiana Historic Bridge Programmatic Agreement (PA) executed August 11, 2006, this report presents a methodology "to identify historic bridges that are most suitable for preservation and are excellent examples of a given type of historic bridge," which are referred to as Select Bridges. Stipulation II.B describes a prioritization process in which the Indiana Department of Transportation (INDOT) will recommend each historic bridge as either Select or Non-Select with input from the Historic Bridge Task Group, County Commissioners, and the public. The Federal Highway Administration (FHWA) and Indiana State Historic Preservation Office (INSHPO) will evaluate the recommendations in light of public comment and issue a final list of Select and Non-Select Bridges.

The methodology described herein establishes a model that gives priority to preservation of historic bridges that are "most suitable for preservation" based on a range of engineering criteria that considers the functionality, safety, feasibility, and cost-effectiveness of long-term preservation. These engineering criteria include structural capacity, deck geometry, roadway and approach width, and others (as factored into a bridge's Sufficiency Rating and Condition Score, which are described below). To meet the intent of the PA whereby "excellent examples of a given type" are selected for preservation, the model prioritizes historic bridges as Select Bridge candidates based on a preservation goal that has been established for each bridge type.

In accordance with the PA, this methodology provides criteria to identify historic bridges as either Select or Non-Select for review by INDOT, the FHWA, and INSHPO. Upon approval by these agencies, the methodology will be available to the Historic Bridge Task Group, County Commissioners, and the public for a 30-day review. After consideration of comments received from these interested parties, the FHWA, in consultation with the INSHPO and in cooperation with INDOT, will review and approve a final version of this methodology. The final methodology will be applied to Indiana's population of historic bridges to determine a list of Select Bridge candidates as outlined in the PA.

2. Definitions

Condition Score – A score given to a historic bridge in vehicular use to measure those factors that control whether or not the bridge can prudently and economically be preserved. The Condition Score indicates the condition of a bridge by isolating and measuring controlling elements.

Eligibility Score – A score given to a historic bridge to measure its historic and engineering significance when compared to other bridges. According to the methodology used for this project, bridges with a score of 1 or higher are considered eligible for listing in the National Register of Historic Places (National Register).

Historic bridge – A bridge that has been listed in or determined eligible for the National Register.

Non-vehicular bridge – A bridge that has been closed, bypassed, or relocated and carries no motorized vehicles.

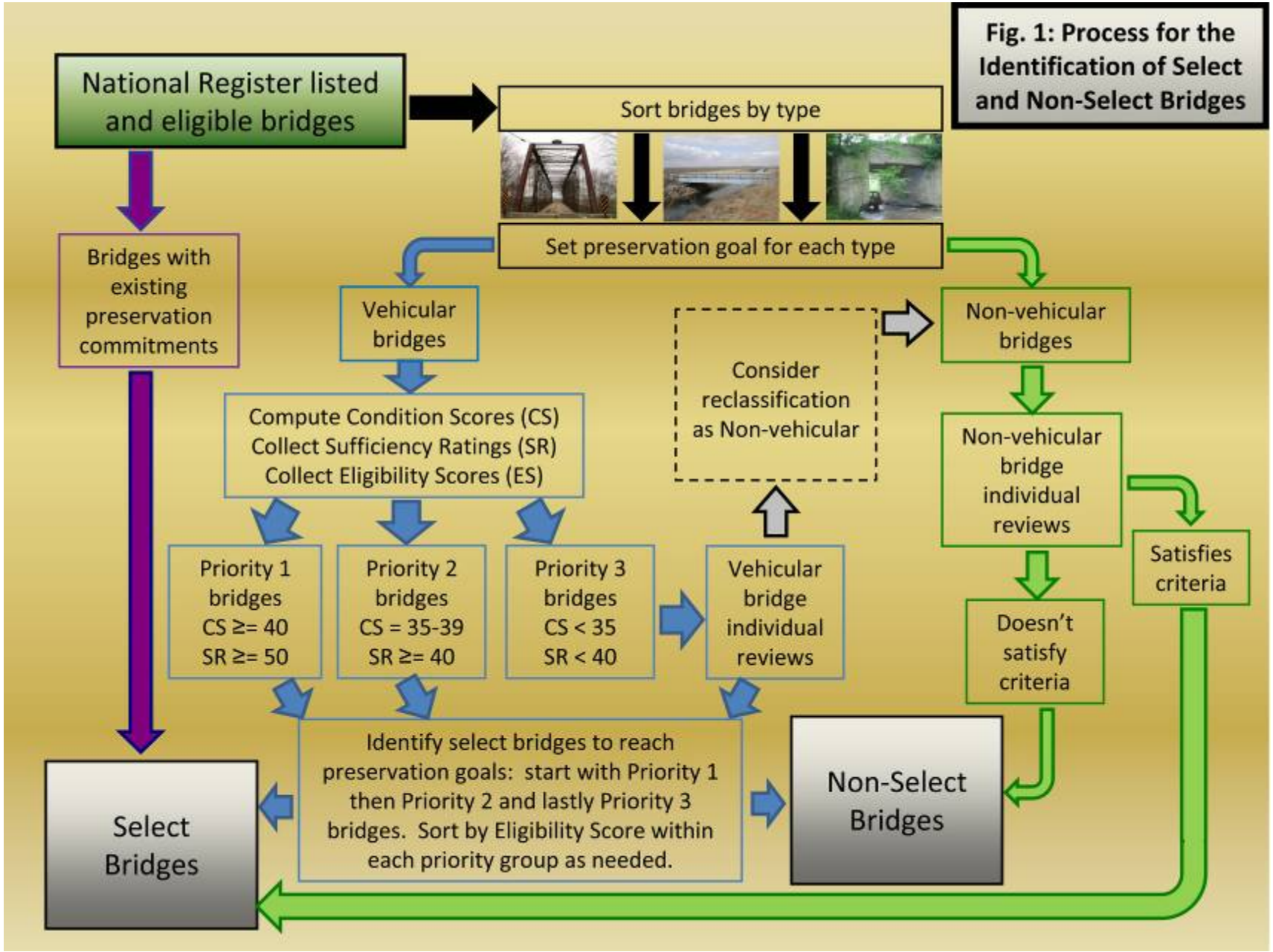
Sufficiency Rating - A method of calculating data for a vehicular bridge to obtain a numeric value indicative of the bridge's sufficiency to remain in service. The result of this method is a percentage in which 100 percent represents an entirely sufficient bridge and zero percent represents an entirely insufficient, or deficient, bridge. The four factors used to calculate this percentage are: 1) structural adequacy and safety (determined by the condition and load capacity characteristics of the bridge), 2) serviceability and functional obsolescence (determined with traffic level and geometric characteristics), 3) essentiality for public use (traffic levels, detour lengths), and 4) special reductions (lack of safety features). See FHWA's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* for more information.

Vehicular bridge – A bridge that actively carries traffic on the local or state roadway system.

3. Methodology

As called for in the PA for Indiana's historic bridges, this methodology serves "to identify historic bridges that are most suitable for preservation and are excellent examples of a given type of historic bridge." Such bridges are referred to as "Select Bridges." Figure 1 illustrates the overall process for identifying Select and Non-Select Bridges. These processes differ for vehicular and non-vehicular bridges due to the different data sets available and different functional requirements based on whether a bridge carries traffic or not. In Figure 1, the process for vehicular bridges is presented in the blue boxes and arrows, while the process for non-vehicular bridges is presented in the green boxes and arrows.

Fig. 1: Process for the Identification of Select and Non-Select Bridges



Two categories of historic bridges are immediately considered to be Select Bridge candidates: 1) non-vehicular historic bridges that are in satisfactory condition to serve a non-vehicular function and 2) historic bridges with an existing preservation commitment in place. Many of these bridges have been moved off the roadway system through either a bypass route or relocation of the historic bridge and are good candidates for continued preservation.

As a mechanism to prioritize the remaining historic bridges, a preservation goal is recommended for each bridge type. The preservation goal is based on the relative abundance of the bridge type within the total population of historic bridges, and the probable threat to bridges of that type based on condition, functionality, and conformance with modern engineering standards.

The preservation goals recognize that uncommon bridge types, such as timber covered and iron truss bridges, warrant a higher targeted percentage for preservation than common bridge types, which generally exhibit better condition and are easier to preserve. For example, covered and iron truss bridges date from an earlier era of bridge construction and are often more threatened due to their lower level of function when assessed by modern engineering standards. More recently introduced bridge types, such as prestressed concrete I-beams, have a higher level of function based on modern engineering standards as evidenced by the fact that this bridge type continues to be built. If engineering criteria alone drove the model to identify Select Bridges, the resulting preservation recommendations would skew the selection heavily toward more recent bridge types.

The preservation goal sets a baseline for the identification of Select Bridge candidates within each bridge type. According to the methodology described herein, the preservation goal for any bridge type can be exceeded if a higher number of historic bridges within a given type meet the established criteria. The preservation goal is established based on the overall population of publicly owned historic bridges in Indiana, including bridges recommended eligible as part of the Indiana Historic Bridge Inventory (now in process to fulfill another requirement of the PA), and bridges that were previously determined eligible or listed in the National Register, including contributing resources in historic districts.

For vehicular bridges, several types of data are required to apply the methodology to identify Select and Non-Select Bridge candidates. The Eligibility Score, which results from applying the points system to evaluate the National Register eligibility of bridges as part of the Indiana Historic Bridge Inventory, is considered (results of the inventory are pending review by agencies and public). The Eligibility Score of each bridge is used to rank its historic merit so that excellent examples of a given type can be given priority. Bridges that were previously determined eligible for or listed in the National Register, including those that are contributing resources in historic districts, were not evaluated during the inventory project. Each of these bridges is assigned 11 points for purposes of applying this methodology.[1] Bridges with an Eligibility Score of 11 or higher are treated equally under this methodology and are considered to be excellent examples of their respective types.

[1] Bridges with 11 points are the statistical top scorers, applying the standard deviation to the bridge population that is recommended eligible as part of this inventory (16% of eligible bridges scored 10.6 or above). Assignment of 11 points to bridges previously determined eligible or listed puts these bridges on equal footing with these top scorers and, more importantly, allows them to be given priority within the described methodology.

This methodology uses two other scores that are based on engineering criteria: the Sufficiency Rating and the Condition Score (see Section 2 – Definitions). The Sufficiency Rating of a bridge is calculated biennially based on an inspection and submitted to the FHWA as part of the National Bridge Inventory (NBI) database. The resulting number is used by the FHWA to determine if a bridge is eligible for federal funding. Bridges with a Sufficiency Rating below 80 are eligible for rehabilitation dollars, while those with a rating below 50 are eligible for replacement. The Sufficiency Rating provides a comprehensive evaluation of the current condition of the bridge, including safety and public use factors. The Sufficiency Rating includes some factors that do not directly apply to whether a structure can be maintained into the future. Because of this, a method to isolate those items that do directly apply to whether a bridge can prudently and economically be preserved was developed specifically for this project. The Condition Score isolates and provides a cumulative evaluation of the elements that are generally considered when evaluating a bridge for long-term preservation (see Appendix A for details on calculating the Condition Score).

Using numbers computed for the Condition Score, Sufficiency Rating, and Eligibility Score, Indiana's historic bridges that carry vehicular traffic are prioritized using the filtering process presented below. These filters provide a mechanism to identify the most suitable bridges to fill the preservation goal for each bridge type. Applying the *Filter to Identify Suitable Vehicular Bridge Candidates for Preservation*, bridges are assigned to one of three groups: Priority 1, Priority 2, and Priority 3. Priority 1 bridges have an excellent Condition Score and a fair-to-excellent Sufficiency Rating. Bridges in the Priority 1 group do not have extensive deterioration and are able to adequately function as part of a roadway system. Priority 2 bridges are in slightly poorer condition and are slightly less able to function as part of their roadway system. Priority 3 bridges are the remaining bridges and need to be evaluated on a case-by-case basis (see Step 6 below).

Filter to Identify Suitable Vehicular Bridge Candidates for Preservation

Priority	Condition Score (see matrix)	Sufficiency Rating	Result
1	≥ 40	≥ 50	Select Bridge candidate
2	35 - 39	≥ 40	If preservation goal is not met in Priority 1, apply *Filter to Identify Excellent Vehicular Bridge Examples of Bridge Type* to prioritize Select Bridge candidates until preservation goal is met
3	< 35	< 40	If preservation goal not met in Priority 2, bridges need individual review to identify Select Bridge candidates (see Step 6)

Priority 1 historic bridges are considered Select Bridge candidates due to their relatively good engineering condition. The preservation goal for any bridge type can be exceeded if a higher number are identified as Priority 1 bridges. If the preservation goal has not been met with Priority 1 bridges, historic bridges in Priority 2, and Priority 3 if necessary, are considered using a second filtering mechanism. Applying the *Filter to Identify Excellent Vehicular Bridge Examples of Bridge Type*, bridges are ranked for historic merit according to their Eligibility Score. This method allows excellent examples within each bridge type that are in the next best engineering condition to be identified as Select Bridge candidates.

Filter to Identify Excellent Vehicular Bridge Examples of Bridge Type

Rank	Excellent examples of type (see evaluation methodology for details)	Result
1	≥ 11 (includes bridges previously determined eligible or listed)	Receives preference to meet preservation goal
2	6 - 10	Second choice to meet preservation goal
3	1 – 5	Considered if preservation goal not met above

Normal Distribution of Data

Within a normal distribution of scoring data, an average score and a standard deviation from that average score will occur. A normal distribution curve, also referred to as a bell-curve (shown below in Figure 2) defines a normally distributed set of data, such as the scoring data for a population of historic bridges. A standard deviation is a measure of the variation among the data points. As shown in the pink shaded area in Figure 2, approximately 68% of the population will have a score within one standard deviation of the average of all scores. Generally applied, 16% of historic bridges will have scores higher than the average score plus one standard deviation and 16% of historic bridges will have scores lower than the average score minus one standard deviation. The percentages provided by this model are applied to bridge type populations to establish preservation goals.

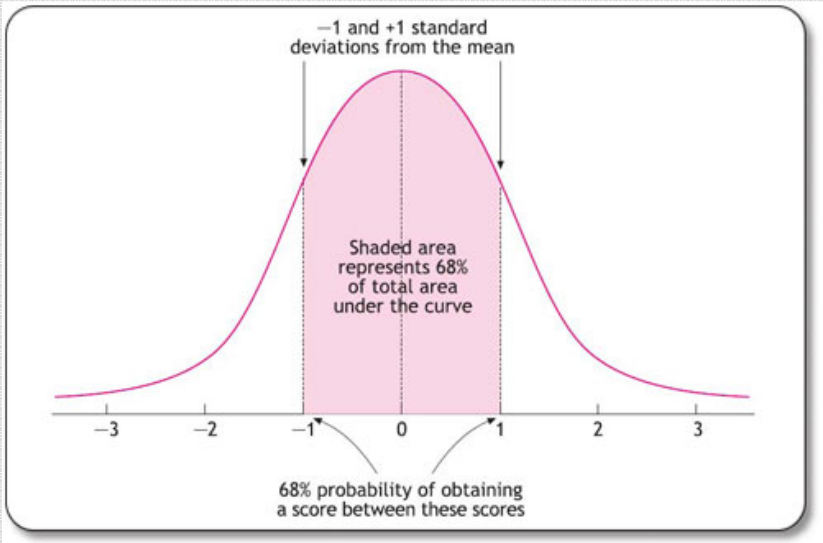


Figure 2. Illustration of Normal Distribution

The following discussion explains the step-by-step process to identify Select and Non-Select Bridges.

Step 1: Establish preservation goals

The recommended preservation goal for each bridge type is achieved by applying the normal distribution of data to identify the greatest number of uncommon bridge types and limit the number of common bridge type examples. Simply stated, a normal distribution of data means that most of the examples in a set of data are close to the "average," while relatively few examples tend to be one extreme or the other.

The use of varied preservation goals provides a mechanism to preserve bridges within types that are most at risk. The normal distribution of data is applied to bridge types to establish a preservation goal in the following manner:

- Common bridge types are set at 16% of the total historic bridge population
- Uncommon bridge types are set at 84% of the total historic bridge population

Tables 1 and 2 identify which bridge types are recognized as common and uncommon.

Table 1
Common Bridge Types

Bridge types	NBI/INDOT code and type
Reinforced concrete slab	101A – Reinforced concrete slab 119A – Reinforced concrete slab – under fill 201A – Continuous reinforced slab
Reinforced concrete girder and beam	102A, 102B, 104 – reinforced concrete girder/beam/tee beam 103 – Reinforced concrete girder - trans. girder/floor beam system 119D – Reinforced concrete girder – under fill 122 – Precast concrete beam/channel beam 202A, 204 – Continuous reinforced concrete girder/tee beam 203 – Continuous reinforced concrete girder - trans. girder/floor beam system
Concrete arch	111A, 119B, 119E – Reinforced concrete arch/arch – under fill; Precast concrete arch – under fill 211 – Continuous reinforced concrete arch
Steel beam	302A, 302D, 302G, 303E, 303H 402A, 402C, 402D
Metal pony truss	310A – Warren 310A – Pratt
Metal thru truss	310B – Warren 310B – Parker 310B – Pratt
Prestressed concrete I-beam	502, 504 – Prestressed concrete I-beam/tee beam 602 – Continuous prestressed beam

Table 1
Common Bridge Types

Bridge types	NBI/INDOT code and type
Prestressed concrete box beam	505, 506 – Prestressed concrete box beams – multiple/spread 605, 606 – Continuous prestressed concrete box beams – multiple/spread

Table 2
Uncommon Bridge Types

Bridge types	NBI/INDOT code and type
Reinforced concrete rigid frame and box	107A – Reinforced concrete rigid frame/box 119C – Reinforced concrete box – under fill 207A, 207B – Continuous reinforced concrete rigid frame/box 219B – Continuous reinforced concrete box – under fill
Concrete arch	111B – Open spandrel reinforced concrete arch 112 – Thru reinforced concrete arch 111C – Unreinforced concrete arch
Metal arch	311 – Metal pipe arch 319A – Multiplate – under fill 312B – Thru steel arch 911 – Aluminum arch 919B – Aluminum multiplate arch – under fill
Steel girder	302C, 302E, 302H, 303B, 303F 402B, 402E, 402H, 403A, 403C, 403D
Steel deck truss	309
Metal pony truss	310A, 310C – Other variations 910B – Iron
Metal thru truss	310B – Other variations 910A – Iron
Steel movable	316 – Bascule
Timber truss	710 – Timber covered bridge
Timber, other	701 – Timber slab 702A – Timber beam 702B – Timber girder 702C – Timber trestle
Stone	811 – Stone arch 819 – Masonry culvert – under fill

For common bridge types, the threshold of 16% captures the probable best examples within a common type while eliminating the average and least satisfactory examples. In this case, the methodology is working to identify candidates that are statistically the best or top examples of a bridge type with a high population.

For uncommon bridge types, the threshold of 84% captures the majority of the population. By selecting the top 16% and the average (those that score within one standard deviation of the average), a preservation goal of 84% works to capture the population that is both the best and average while

eliminating the lowest scoring and, therefore, the least likely bridges to be preserved. In this case, the methodology is working to identify the maximum number of candidates of uncommon bridge types due to a smaller population and/or greater threats to their continued existence.

Step 2: Prepare data for review (vehicular and non-vehicular bridges)

- Sort historic bridges into major bridge types, as indicated in the left hand column of Tables 1 and 2.
- Determine and separate vehicular and non-vehicular bridges.
- Identify bridges that have an existing preservation commitment. Such bridges are categorized as Select Bridge candidates and no additional evaluation is conducted.
- For vehicular bridges, compute Condition Score according to the *Condition Score Matrix* illustrated in Appendix A and collect Sufficiency Ratings from the NBI, if available.
- For vehicular bridges, collect Eligibility Score from the *Indiana Historic Bridge Database* for each historic bridge. Previously listed and eligible bridges receive 11 points as the Eligibility Score. *Note: Results of the eligibility determinations for Indiana's pre-1966 bridge population, including computed Eligibility Score, are currently being reviewed by agencies.*

Step 3: Conduct quality review of data

- Review historic bridges with poor NBI condition ratings (4 or below) and revise ratings in consultation with INDOT only if warranted. Such revisions would affect a bridge's Sufficiency Rating and Condition Score.
- Compare Condition Score and Sufficiency Rating to identify historic bridges with large differences and work with INDOT to reconcile, which may involve completing limited field inspection.

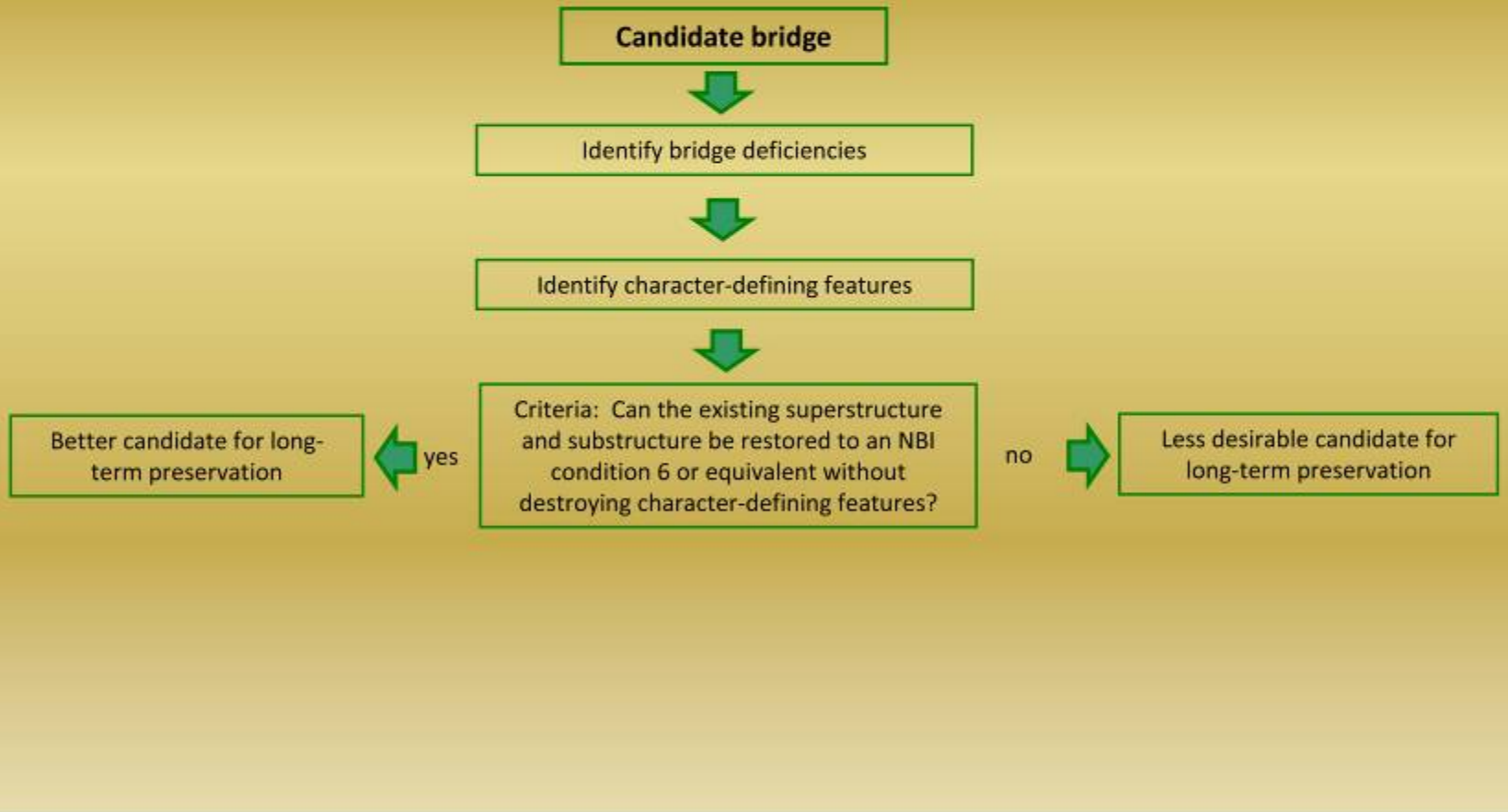
Step 4: Identify non-vehicular Select Bridge candidates within each bridge type

- Identify deficiencies of the bridge.
- Identify character-defining features from *Historic Bridge Database* and field survey photos.
- Apply the criteria as outlined in Figure 3 to individually review non-vehicular bridges.
- Determine if primary components of the bridge (superstructure and substructure) can be restored to a satisfactory condition (NBI condition 6 or better, or equivalent) without destroying character-defining features.

- If the answer is “yes,” non-vehicular historic bridges will be considered Select Bridge candidates.

- If the answer is “no,” non-vehicular historic bridges will be considered Non-Select Bridges due to the likelihood that the historic integrity of the bridge would be lost through required preservation efforts and it would take more resources to preserve the bridge on a long-term basis.

Fig. 3: Non-Vehicular Bridge Individual Review Process



Step 5: Identify Priority 1 and 2 vehicular bridge candidates for Select Bridge status

- Applying the *Filter to Identify Suitable Vehicular Bridge Candidates for Preservation,* prioritize the best candidates for preservation efforts within each bridge type based on Condition Score and Sufficiency Rating.

- If the bridge is on a low-volume roadway, determine if it meets the low-volume test (see Appendix B for *Low Volume Road Matrix*). A bridge that does not meet this test would require individual review to determine if it can be a Select Bridge candidate.

- Historic bridges that meet the criteria for Priority 1 will be considered Select Bridge candidates. If the goal is met or exceeded, the process ends. If the goal is not met, proceed to Priority 2 and then Priority 3 bridges, if needed, until it is met.

- Rank Priority 2 bridges by Eligibility Score applying the *Filter to Identify Excellent Vehicular Bridge Examples of Bridge Type*. Bridges with an Eligibility Score of 11 or higher are preferred, with bridges scoring 6 to 10 points considered next, and finally bridges with 1 or more points. When the preservation goal for each bridge type is met, the process ends. If the preservation goal is not met with Priority 2 bridges, Priority 3 candidates are considered under the individual bridge review in Step 6.

Step 6: Identify Priority 3 vehicular bridge candidates for Select Bridge status

- Determine bridge type(s) with preservation goals not met in Step 5.

- Rank Priority 3 candidates within each bridge type, applying the Filter *to Identify Suitable Bridge Candidates for Preservation* and *Filter to Identify Excellent Vehicular Bridge Examples of Bridge Type*.

- Identify deficiencies leading to low Condition Score from matrix.

- Identify character-defining features from the *Historic Bridge Database* and field survey photos.

- Apply the series of checks, as outlined in Figure 4, to individually review vehicular bridge candidates. The maximum number of points a candidate bridge can receive is 100. The points are determined from the Condition Score (multiplied by 0.25), the Eligibility Score, and points awarded based on the outcome of five checks as follows:

    1. To determine the capability to bring the primary components of the bridge (superstructure and substructure) to a satisfactory condition (NBI condition 6 or better). If the primary components are in fair or poor condition, it will take more resources to preserve the bridge on a long-term basis.

2. To identify if the bridge has adequate load capacity for the roadway system. A bridge may be in excellent condition but have marginal load capacity. Bridges with adequate load capacity are better candidates for long-term preservation.

3. To check the bridge's geometrics. Are the clearances, lane widths, and shoulder widths appropriate for the roadway system? Functionally obsolete bridges are more difficult to maintain on a vehicular system.

4. To determine if deficiencies of the bridge are associated with the character-defining features. If they are, there is a greater likelihood the historic integrity of the bridge would be lost through required preservation efforts.

5. To assess additional factors relevant for long-term preservation, including:

    - Use of salts (based on owner's information and/or visual inspection) – Bridges that have been salted to prevent icy conditions during the winter are likely to be contaminated with chlorides. If the salted bridge is contaminated with chlorides, it could readily lead to accelerated deterioration. This primarily impacts concrete bridges (both conventionally reinforced and prestressed); however, paint systems on the steel bridges can be contaminated with chlorides as well, which impact future coating decisions.

    - Sag vertical curves – Bridges located in sag vertical curves are likely to have additional roadway drainage, which may accelerate deterioration of components. Sag vertical curves connect the roadway grades on each side of a depressed feature (e.g. a valley). They typically contain the "low point" of a section of roadway that receives roadway drainage from two directions.

    - Open deck joint details – Permit roadway drainage to accelerate the deterioration of components.

    - Unusually high accident rates – Indicate safety issues that need to be addressed.

    - Long detours – Bridges with inadequate load capacity requiring long detours (greater than 10 miles) for emergency vehicles are less attractive for long-term preservation.

- A vehicular bridge failing checks 1, 2, or 3 may be considered for preservation as a non-vehicular bridge (see Step 4).

- Continue to perform checks on the highest ranked candidates until the preservation goal is met for each bridge type.

- Code remaining bridges to Non-Select Bridge status.

Fig. 4: Vehicular Bridge Individual Review Process

Maximum individual review score is 100 points.
* Consider non-vehicular preservation

Step 7: Agency review

In accordance with the PA, the Historic Bridge Task Group, County Commissioners, and the public will be provided an opportunity for review and comment. After consideration of comments received from these interested parties, FHWA, in consultation with the INSHPO and in cooperation with INDOT, will review and approve a final list of Select Bridge candidates. As a result of comments received, FHWA and INSHPO may:

- Increase or decrease the number of Select Bridge candidates within any bridge type.
- Consider other factors not provided in the methodology, such as:
  - Development pressure (which could be extrapolated from growth trends indicated in census data)
  - Community support and/or anticipated future preservation commitments
  - Location within a potential historic district
  - Geographic distribution of bridges
  - Other special circumstances as defined during the review of comments and consultation between the FHWA, INDOT, and INSHPO

4. Special Circumstances and Periodic Updates

This report provides a methodology to identify Select and Non-Select Bridges as stipulated in Indiana's PA for historic bridges. The methodology applied to Indiana's historic bridge population in conducting the statewide historic bridge inventory and identifying Select Bridge candidates provides a consistent and replicable approach to identifying the best candidates for preservation. However, there may be rare situations when the status of an individual bridge will require reconsideration.

Stipulation II.C of the PA provides for the reevaluation of a Select Bridge if unusual circumstances lead to the bridge no longer being able to meet the criteria outlined in this methodology. Examples include, but are not limited to, natural disaster or structural failure. In such circumstances, a bridge owner may request that the FHWA, INDOT, and INSHPO reevaluate the status of a Select Bridge. The PA outlines the process that will be used as follows:

- Bridge owner submits a request in writing to INDOT that describes the unusual circumstance and how the bridge no longer meets the criteria.

- INDOT determines if the request has merit. If so, INDOT will notify the FHWA, INSHPO, the Historic Bridge Task Group, and the public of the request to change the status from Select to Non-Select and solicit comments within 30 days.

- INDOT will then provide the request and any comments received to FHWA and INSHPO. FHWA and INSHPO will consult to evaluate the request and consider the comments.

- If FHWA and INSHPO agree on the status of the bridge as Non-Select, FHWA will notify INDOT of the decision within 30 days after receiving the request and comments. INDOT will then notify the bridge owner, the Historic Bridge Task Group, and individuals that provided comments of the decision.

- If FHWA and the INSHPO do not agree on the status of the bridge as Non-Select, then the parties will invoke the Dispute Resolution provision, as provided in the PA.

At least every ten years, FHWA, INDOT, and INSHPO will consult to determine if conditions have changed that would require updating the list of historic bridges, the criteria for identifying Select and Non-Select Bridges, and the list of Select and Non-Select Bridges. Any signatory of the PA may request that an update be completed more frequently if there have been substantial changes to the population of historic bridges. The PA is available on the INDOT project website at http://www.in.gov/indot/7035.htm.

Appendix A Condition Score Matrix

The *Condition Score Matrix* was developed for this project as a tool to estimate the potential for preservation of historic bridges that carry vehicular traffic. The matrix automates the screening process by isolating those factors that tend to control whether a bridge can prudently and economically be rehabilitated and therefore preserved. The Condition Score also provides an early indication of whether a bridge is in good or poor condition by isolating controlling elements. Values utilized in the matrix are extracted from the National Bridge Inventory (NBI) database as follows:

- Superstructure and substructure condition
- Structural capacity
- Overall structural evaluation
- Roadway width compared to ADT
- Roadway width compared to approach width
- Deck geometry evaluation
- Waterway adequacy
- Approach roadway evaluation

The *Condition Score Matrix* compares the NBI values and assigns a score for each item listed, with 5 being the maximum, to arrive at a composite score. NBI ratings of 5 or more are assigned a value of 5. A rating of 4 provides an indication of less potential for preservation. NBI values of less than 4 for a particular metric are assigned a value of 0 within the matrix to indicate a lower potential for preservation due to a low NBI rating.

The individual values are tabulated in the matrix to arrive at a Condition Score that is utilized as previously described to assist in determining the potential for perservation. Values of 40 or above indicate a higher potential for perservation. This number was arrived at by performing a statistical analysis of a representative sample of historic bridges. An average score and a standard deviation were determined from that sample. A Condition Score value of 40 corresponds to a value of the mean plus one standard deviation. Those bridges with a Condition Score value of 40 or above constitue the upper 16% scoring bridges of that population. Values of 40 or above indicate a higher potential for preservation. Lower values indicate a bridge that has a number of elements that are in poor condition and therefore is less suitable for preservation.

Indiana Historic Bridge Inventory - Condition Score Matrix

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NBI Number	Structure Number 00227 3200173 / Structure Type: = 111A Simple R/C Arch / Location: Hendricks County / Criteria	NBI Number	Assesment
64B	Structural Capacity (Tons)	16	2.2
67	NBI Structural Evaluation	4	4.0
59	NBI Superstructure Rating	5	5.0
60	NBI Substructure Rating	5	5.0
51/114	Roadway Width Compared to ADT (NBI Factor H)	1	4.6
51/32	Approach Width Compared to Bridge Roadway Width		0.0
68	NBI Deck Geometry Evaluation	3	0.0
71	Waterway Adequacy	7	5.0
72	NBI Approach Roadway Alignment Evaluation	4	4.0
	Total Condition Score		**29.8**

DATA INPUT FROM NBI RECORDS

28	Number of Lanes	1.0
29	ADT=	198
30	ADT Year =	2002
32	Approach Width=	21.0
51	Roadway Width	17.7
59	NBI Superstructure Rating	5
60	NBI Substructure Rating	5
64B	Struct Cap.=	16
67	NBI Structural Evaluation	4
68	NBI Deck Geometry Evaluation	3
71	Waterway Adequacy	7
72	Approach Alignment Evaluation	4
114	Future ADT	294.0
115	Future ADT Year	2022

SR Factor H 1.13

(X) ADT/Lane = 198

(Y) Width/Lane= 17.7

Assessment Legend

Indicates User Input Required or Values Read from NBI

Indicates assigned values corresponding to the NBI rating with a maximum value of 5 to a lower value of 0

If less than 400 then use Low Volume Matrix

Appendix B Low Volume Road Matrix

The *Low Volume Road Matrix* was created to provide an initial screening for bridges with an Average Daily Traffic (ADT) less than 400 to determine if the bridge would pass the structural capacity and bridge width criteria listed in the *Indiana Design Manual Section 72-7.0, Treatment of Historic Bridge on Low-Volume Local Road*. The matrix tests the structural and functional criteria shown in Figures 07-05A and 07-05B. If a "yes" value is returned from both tests, that particular bridge will satisfy the criteria without modification and can be considered as a Select Bridge candidate. If a "no" value is returned, the bridge would need individual review.

Indiana Historic Bridge Inventory - Low Volume Road Matrix

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NBI Number	Structural Criteria	Detour Length < 5Mi	5 mi <= Detour Length < 10 Mi	Detour Length >10 Mi
	Structure Number 00227 3200173			
	Structure Type 111A Simple R/C Arch			
64B	Structural Capacity (Tons)	15-27	27	27-36
114	Future ADT < 100	no	no	no
114	100 < = Future ADT < = 400	no	no	no
	Functional Criteria			
51	Bridge Width (feet)	15-16	18-20	
28	Lanes on Bridge	1	1	
114	Future ADT < 100	no	no	
114	100 < = Future ADT < = 400	yes	no	

DATA INPUT FROM NBI RECORDS

19	Detour Length	1
51	Roadway Width =	17.7
28	Number of Lanes	1
114	Future ADT	294
64B	Struct Cap.=	16